

# **(Bio)Energy for Sustainable Food Systems**

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**presented at the GIZ-DIE (for BMZ) Symposium „Sustainable Energy for Food - Challenges and solutions for sustainable energy use in the agriculture and food sector“  
Bonn, June 12, 2014**



**IEA Bioenergy**



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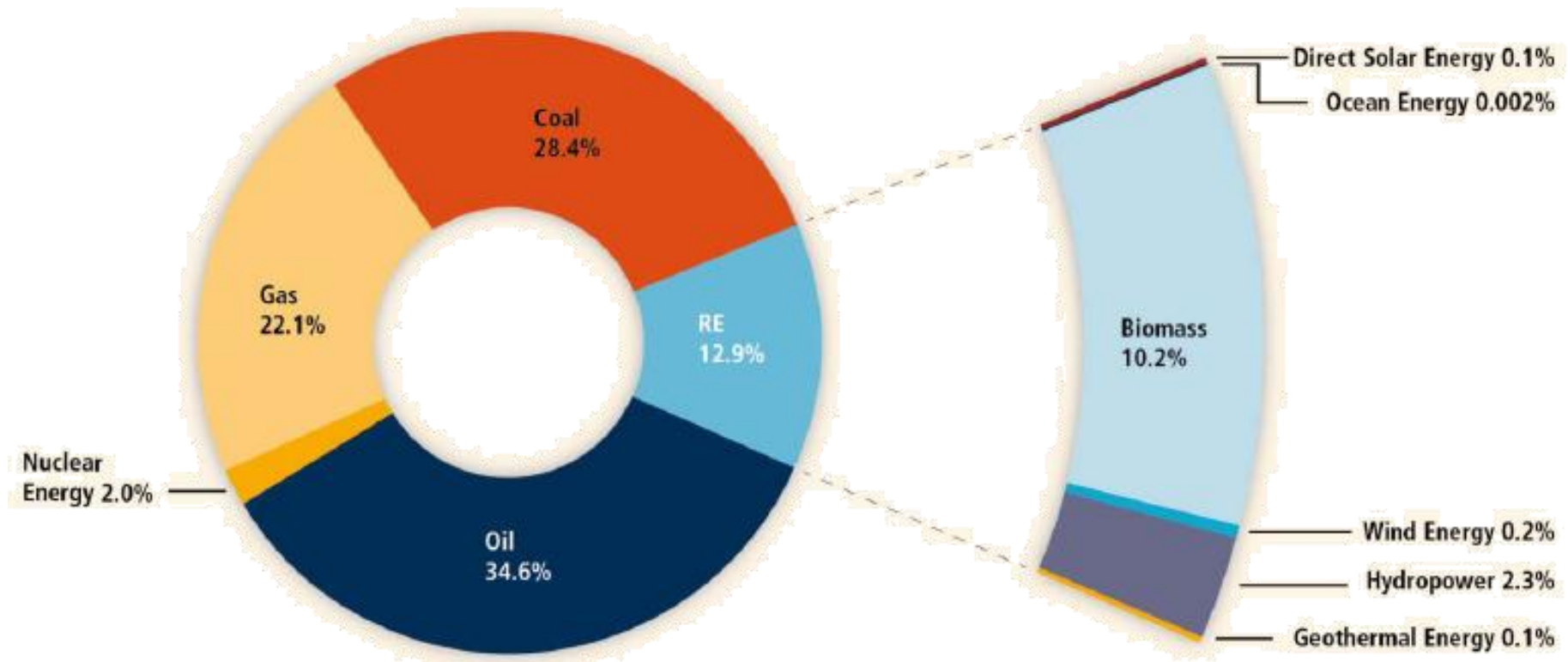
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# Context: Projects, Studies...

-  **Global Assessments and *Guidelines* for Sustainable Liquid Biofuel Production in Developing Countries** (FAO/UNEP/UNIDO)
-  **Indicators for Sustainable Bioenergy**  
<http://www.globalbioenergy.org>
- **IEA Bioenergy** Sustainability of certified **wood bioenergy** feedstock supply chains: **Ecological, operational and international policy perspectives**. IEA Bio Tasks 40 + 43
- **biomass** policies Sustainable bioenergy in EU28 [www.biomasspolicies.eu](http://www.biomasspolicies.eu)
-  **S2Biom** Resource-efficient bioeconomy in Europe [www.s2biom.eu](http://www.s2biom.eu)
-  **BioTrade2020+** Supporting a Sustainable European Bioenergy Trade Strategy (IEE)  
[www.BioTrade2020plus.eu](http://www.BioTrade2020plus.eu)
-  **eupopp** Sustainable Food in the EU-27 until 2030 (FP7)
- Internal IINAS work on sustainable food systems (just starting...see [www.iinas.org/food](http://www.iinas.org/food))

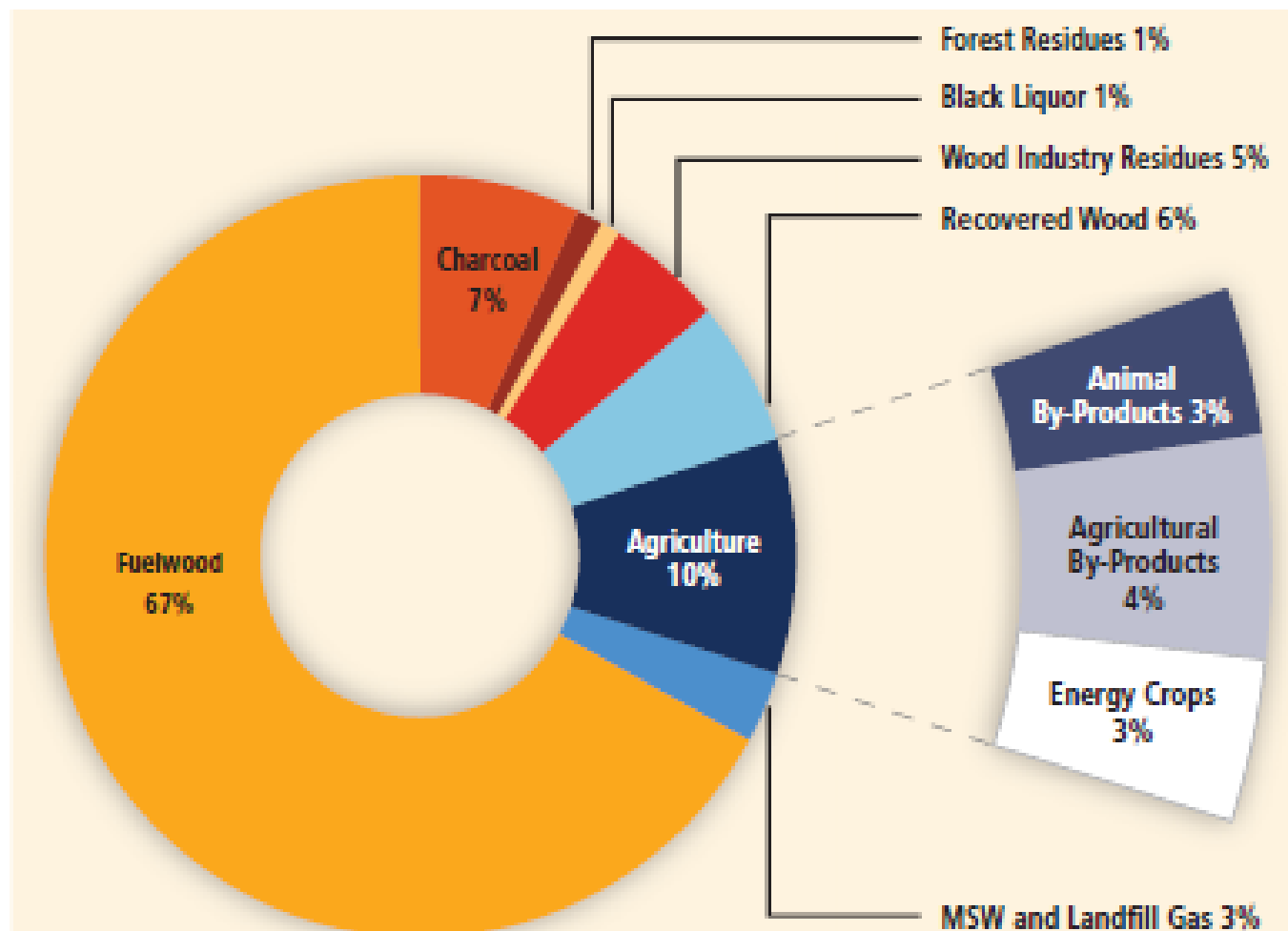
# Global Energy in today...



Total primary energy: approx. 500 EJ; biomass share 50 EJ, of that 20% “modern” bioenergy

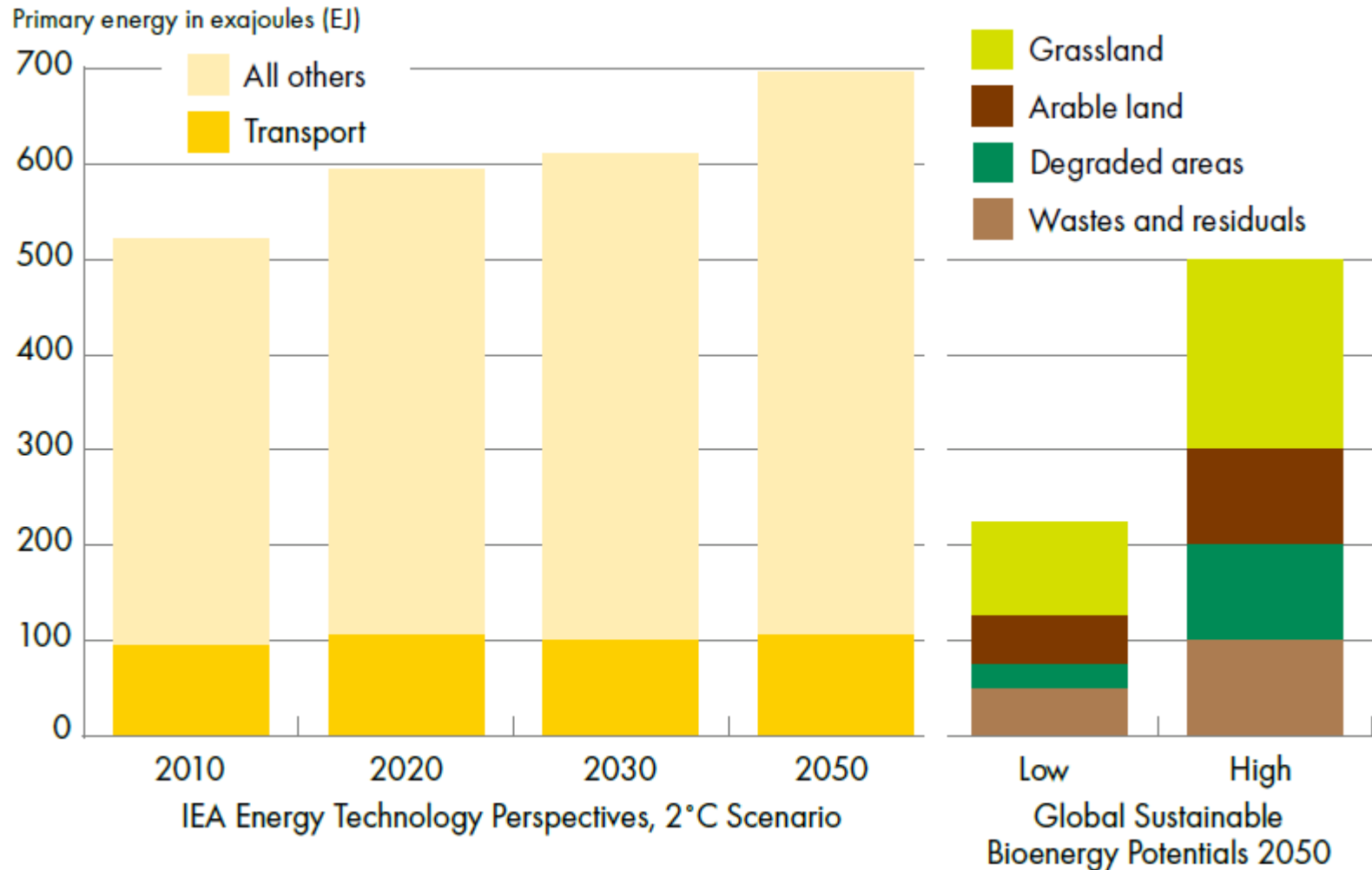
Source: IPCC Special Report on Renewable Energies (2011); data for 2008-2010

# Bioenergy: Global Shares



Source: IPCC Special Report on Renewable Energies (2011)  
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# Global Bioenergy Potentials



Source: IINAS, IFEU (2012) from IEA (2012a), IPCC (2011), Fritsche et al. (2010)

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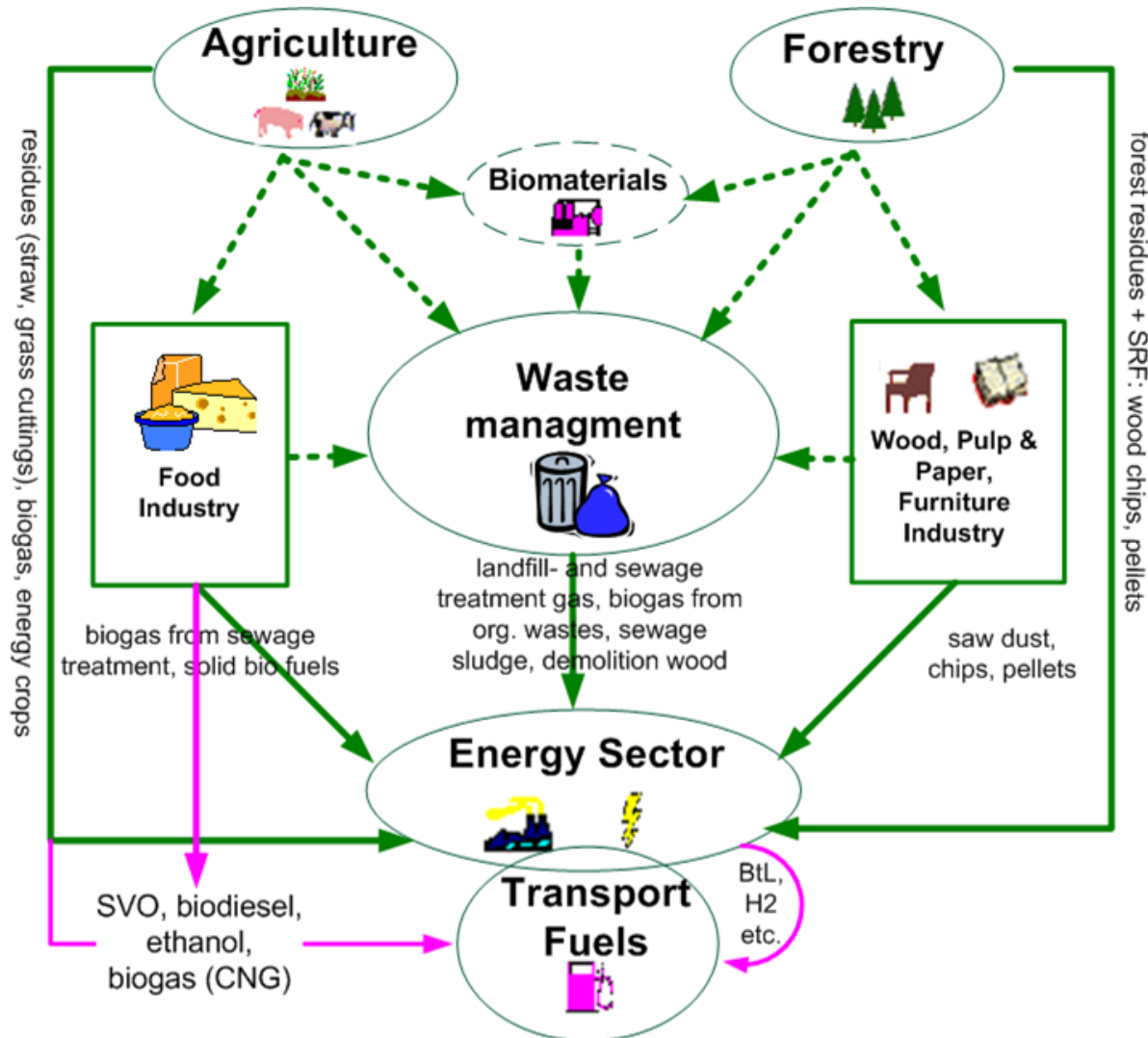
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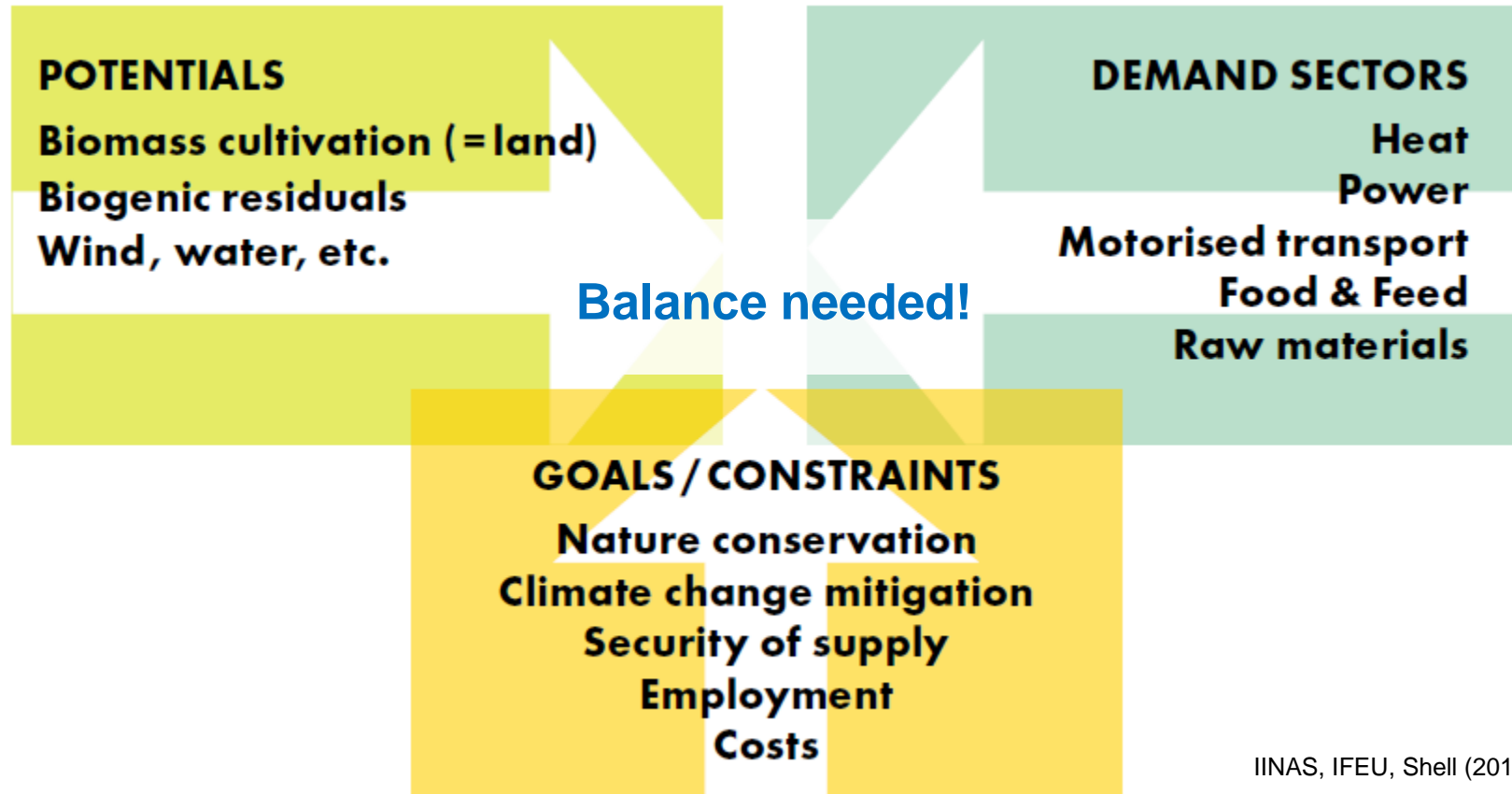
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# Consider all Biomass Flows



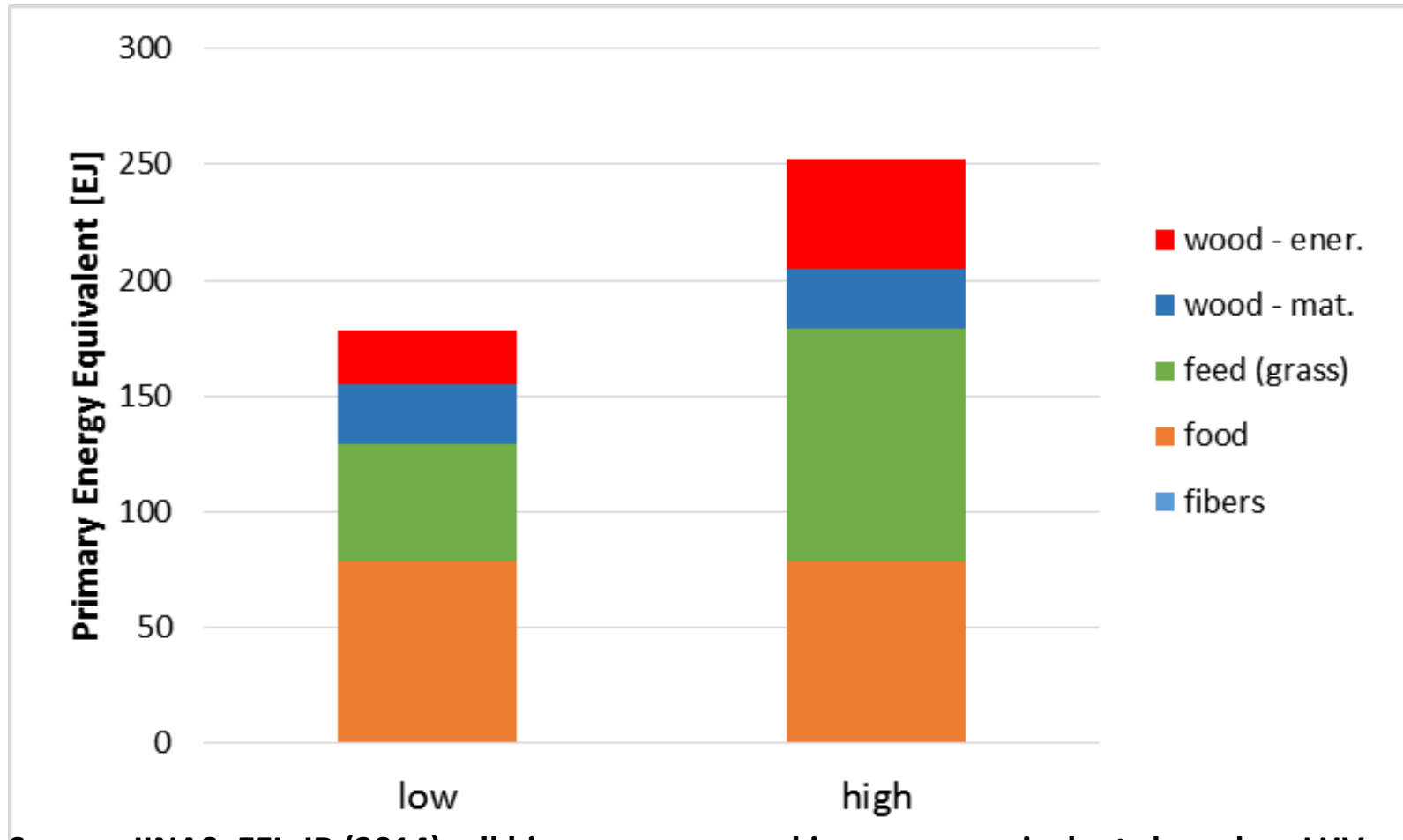
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# Competing Uses for Biomass...



IINAS, IFEU, Shell (2012)

# Biomass: Food, Feed, Fiber, Fuels...



Source: IINAS, EFI, JR (2014); all biomass expressed in energy equivalents based on LHV; data for global supply 2008-2010

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# Resource Efficiency: Cascading...

## Biomass crops



## Material Use



## Residues/wastes



## Energy Use



# Bioenergy Opportunities

- New cultivation systems **enrich agro-biodiversity** (but avoid invasive species)
- Landscape management needed to avoid monotony, and to maintain corridors (migration etc.)
- Better **water management** to secure ecosystem functions – bioenergy crops can be **more drought-tolerant** than agricultural crops, perennials can improve water retention
- **Income** from landscape/habitat management **residues** for bioenergy: care needed, interesting opportunity (German examples: <http://www.lpv.de>)

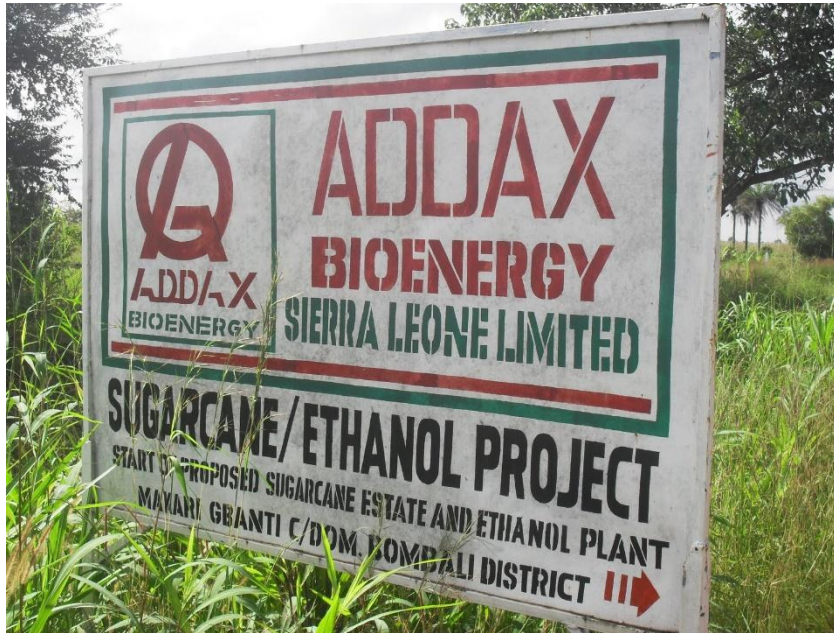
- Rural development + access to modern energy can reduce deforestation pressure → key role for bioenergy
- **Intercropping** with food and agroforestry + **cultivation of perennial crops** on low-carbon and degraded land improves C balance and helps restoring soils → reduces land competition



“**Green walls**” can deliver fuelwood and modern bioenergy providing income and offer “base” for agroforestry → improve food security in parallel

[http://www.thegef.org/gef/video/great\\_green\\_wall](http://www.thegef.org/gef/video/great_green_wall)

- Bioenergy = opportunities, but development **needs “steering”** (GBEP Sustainability Indicators, [www.globalbioenergy.org](http://www.globalbioenergy.org))
- Agriculture often underdeveloped, bioenergy investment **helps** improving yields & infrastructure (**Addax** Sierra Leone)



Germany and FAO started  
VGGT project in Sierra Leone →

opportunity to **mainstream** Addax  
experience!

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## European Policies to promote sustainable consumption patterns: Collaborative project under FP7 – Theme 6 (Environment)

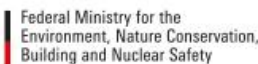
Consortium of 7 partners from 5 different EU regions:

Finland  
Germany  
Latvia  
Spain  
UK

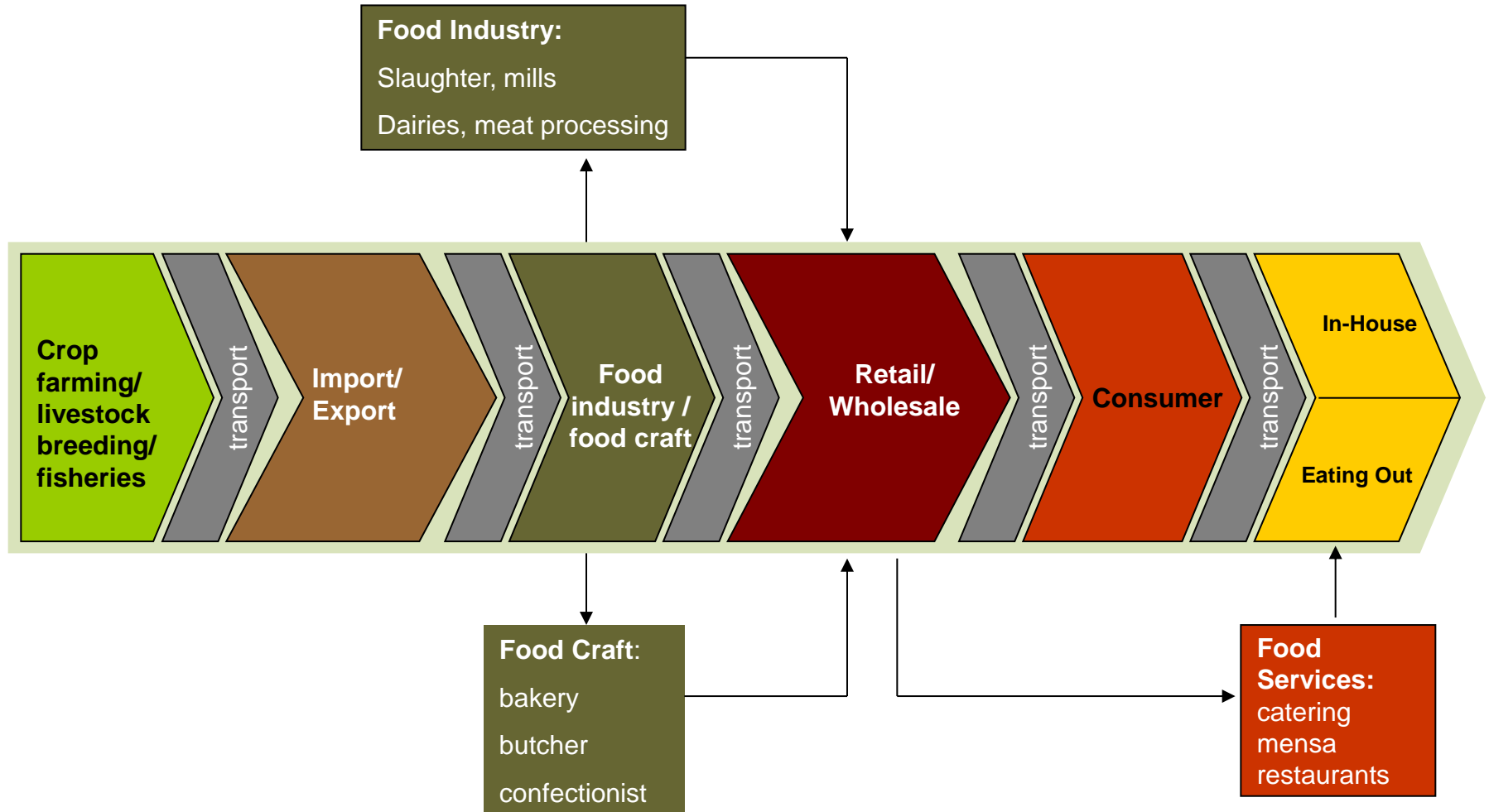


Project duration: August 2008 – July 2011; info: [www.eupopp.net](http://www.eupopp.net)

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# Food Value Chains: “field to fork”



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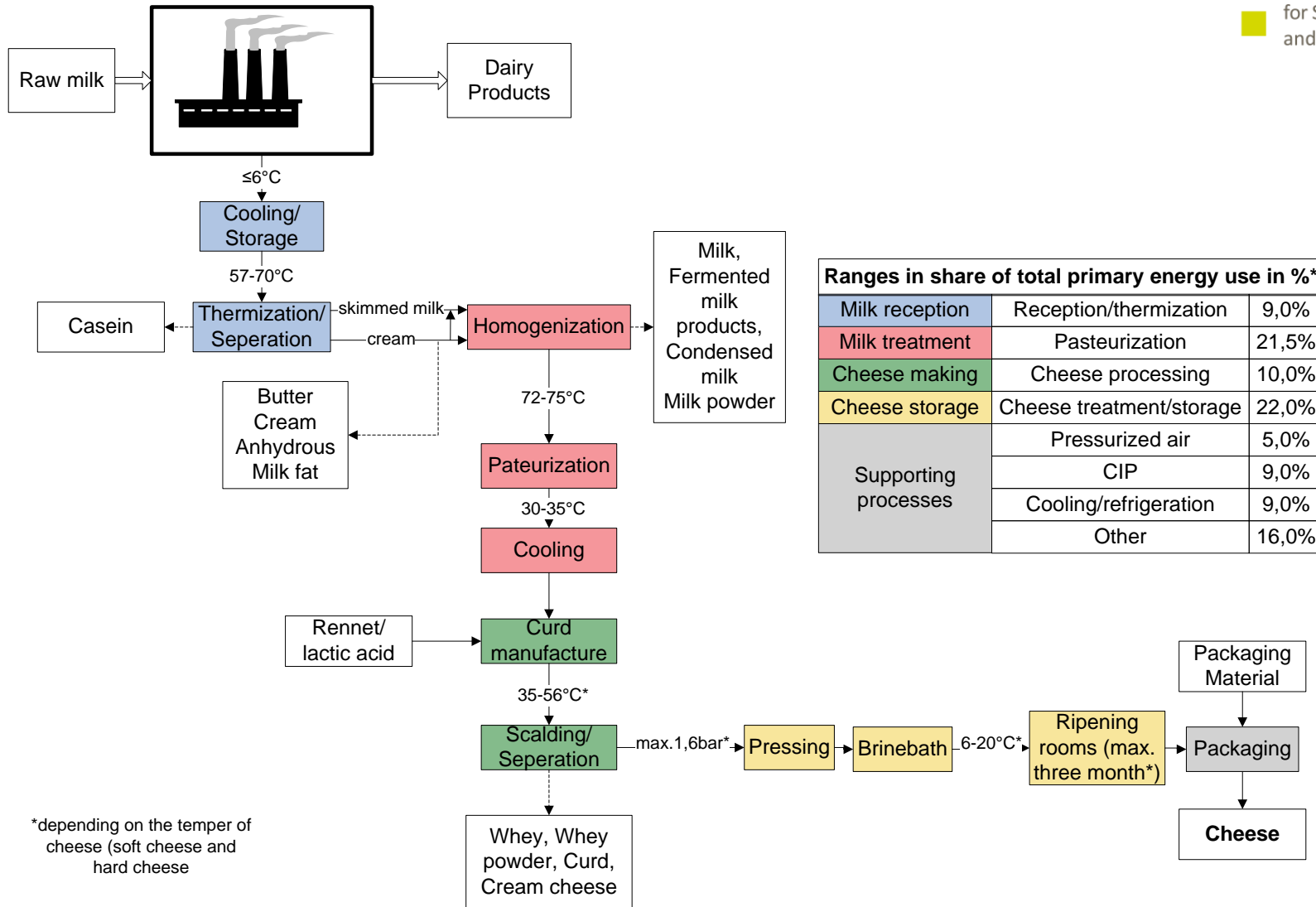
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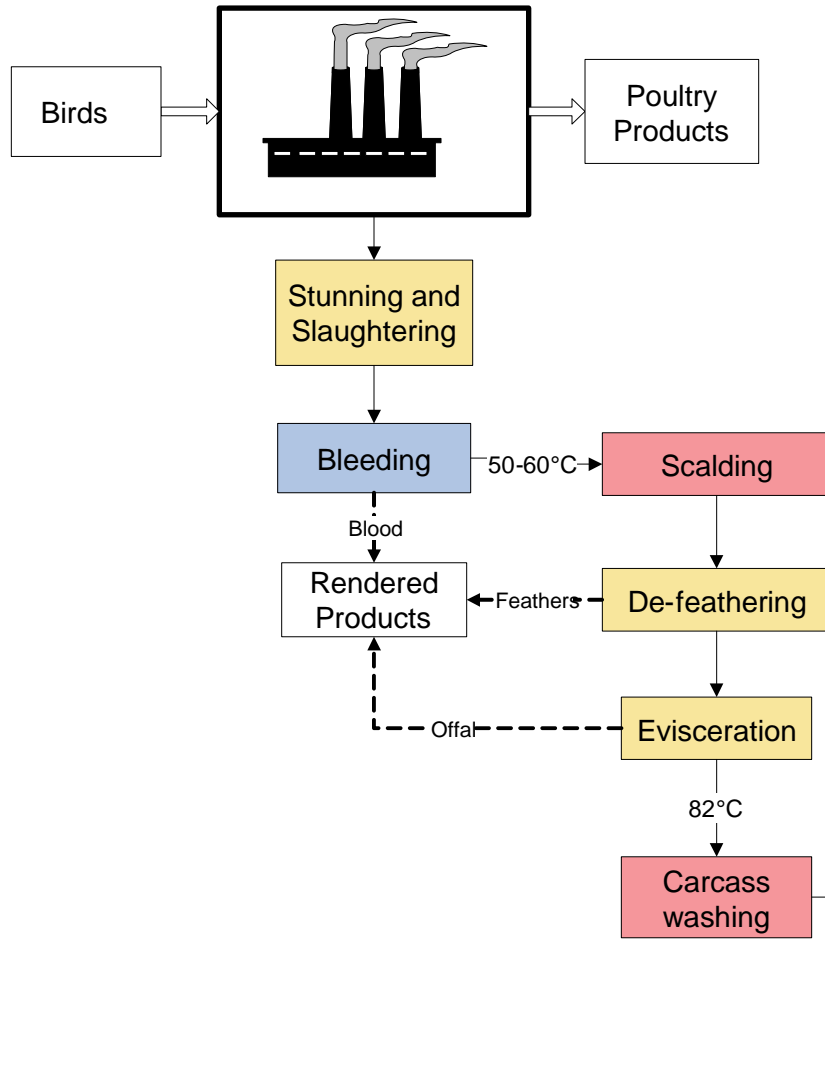
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# MFA: Production of Cheese



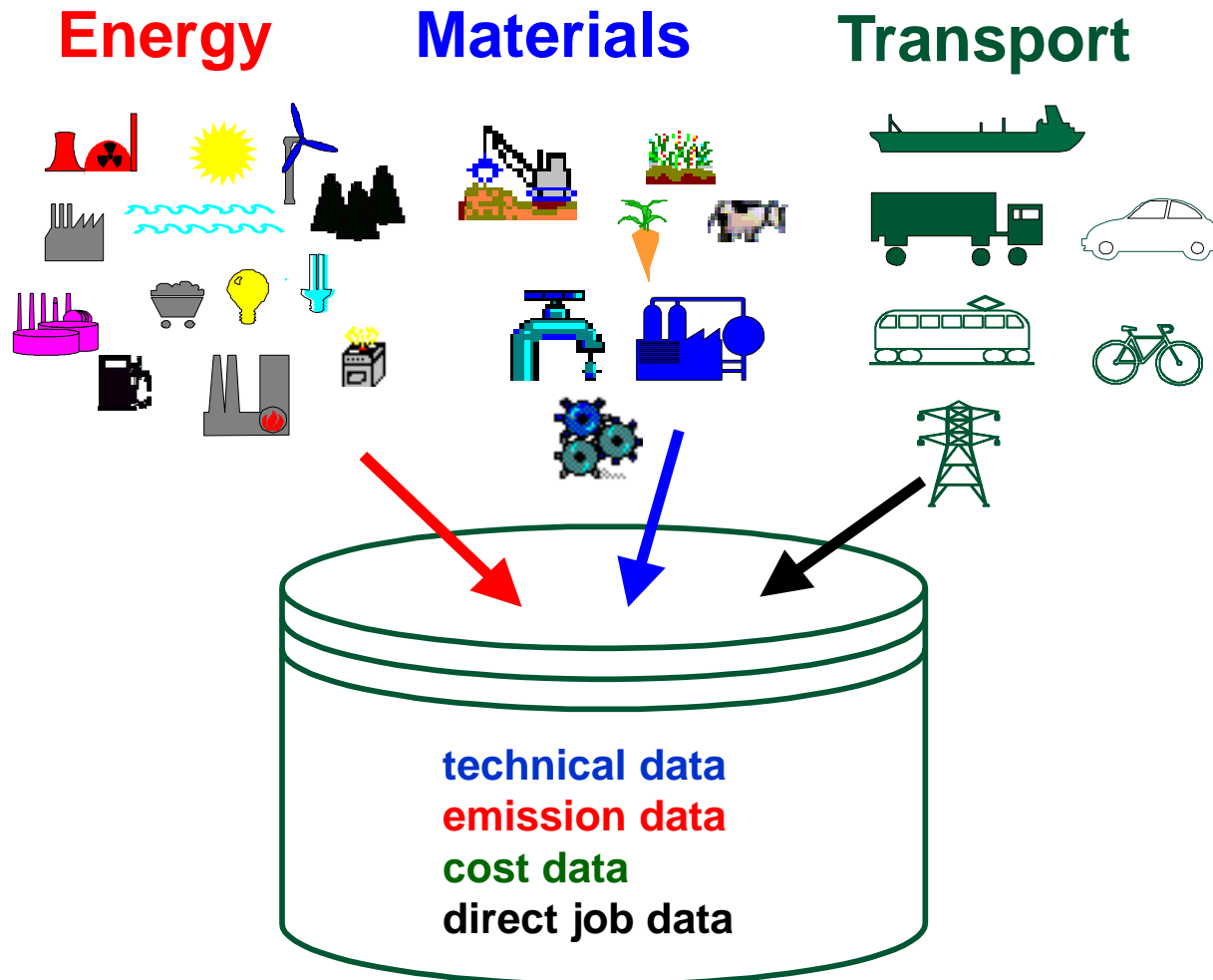
\*depending on the temper of  
cheese (soft cheese and  
hard cheese)

# MFA: Production of Poultry



Ranges in share of energy use in %*		
	Fuel	Electricity
Cooling		52%
Machines		22%
Compressed air		8%
Pumps		10%
Lighting and ventilation		4%
Singeing	60%	
Cleaning and disinfection	30%	
Space heating	10%	
Others		4%





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# Final Thoughts

- **Bioeconomy**: **not** food/feed vs. fuel but **land use**
- Wastes (cascading) and residues: **yes**, but consider biodiversity and soil C stocks (straw...)
- Marginal and degraded land: **yes**, but biodiversity and social safeguards → synergies (soil, jobs)!
- **Integrated** agro-energy-water and forest-energy projects needed to deliver on synergy opportunities
- **Land** use (agro, forest...) is key, and (bio)energy must be **part of sustainable food systems**

# More Information



**IINAS**  
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**Possibilities of sustainable woody energy trade and impacts on developing countries**

**Final Report for GIZ**

prepared by

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Darmstadt, Madrid, Sao Paulo, January 2014

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**E F I**  
JOANNEUM RESEARCH

**Sustainability Assurance for Energy from Forestry**

**- Final Report -**

prepared for WWF International

by

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**IINAS - International Institute for Sustainability Analysis and Strategy**  
EFI - European Forest Institute  
JR - Joanneum Research

Darmstadt, Madrid, Joensuu, Graz

June 2014

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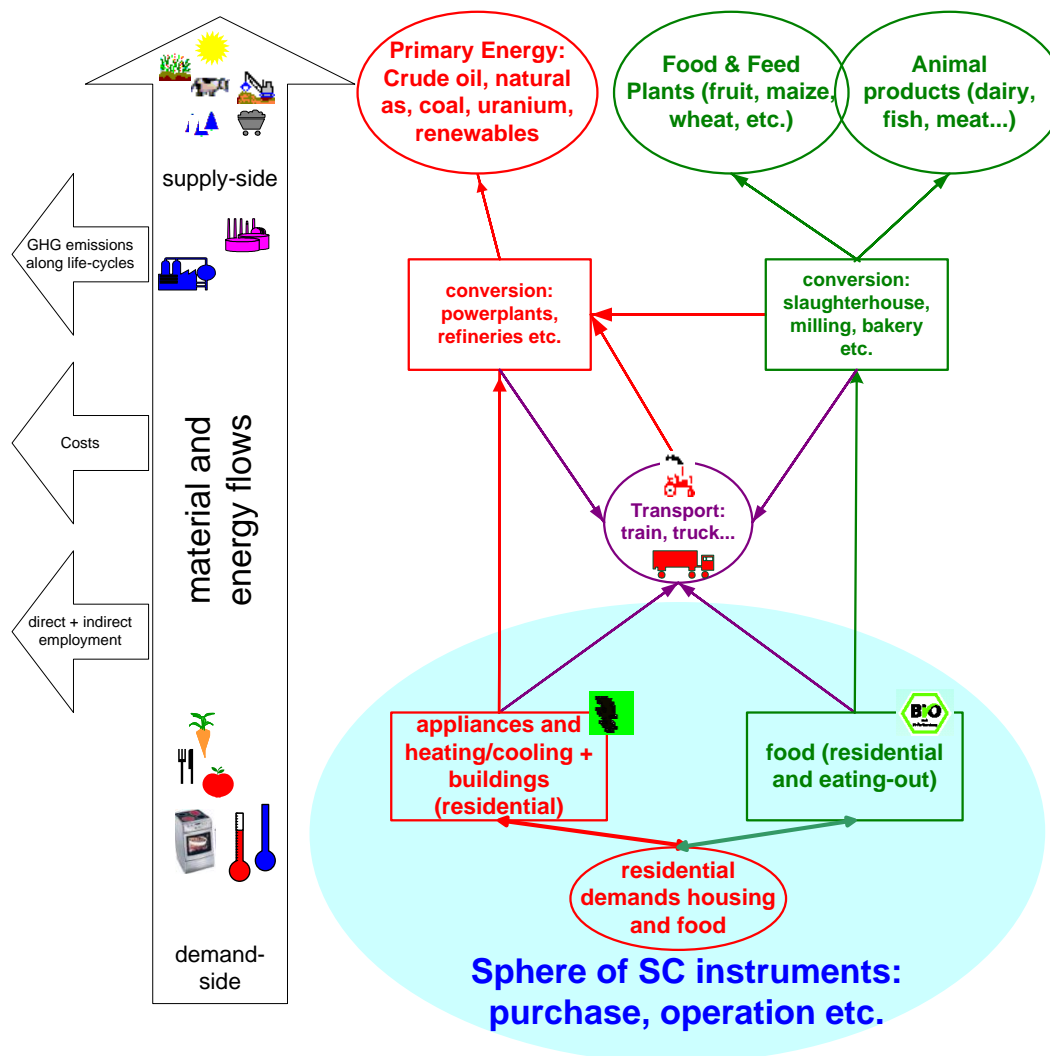


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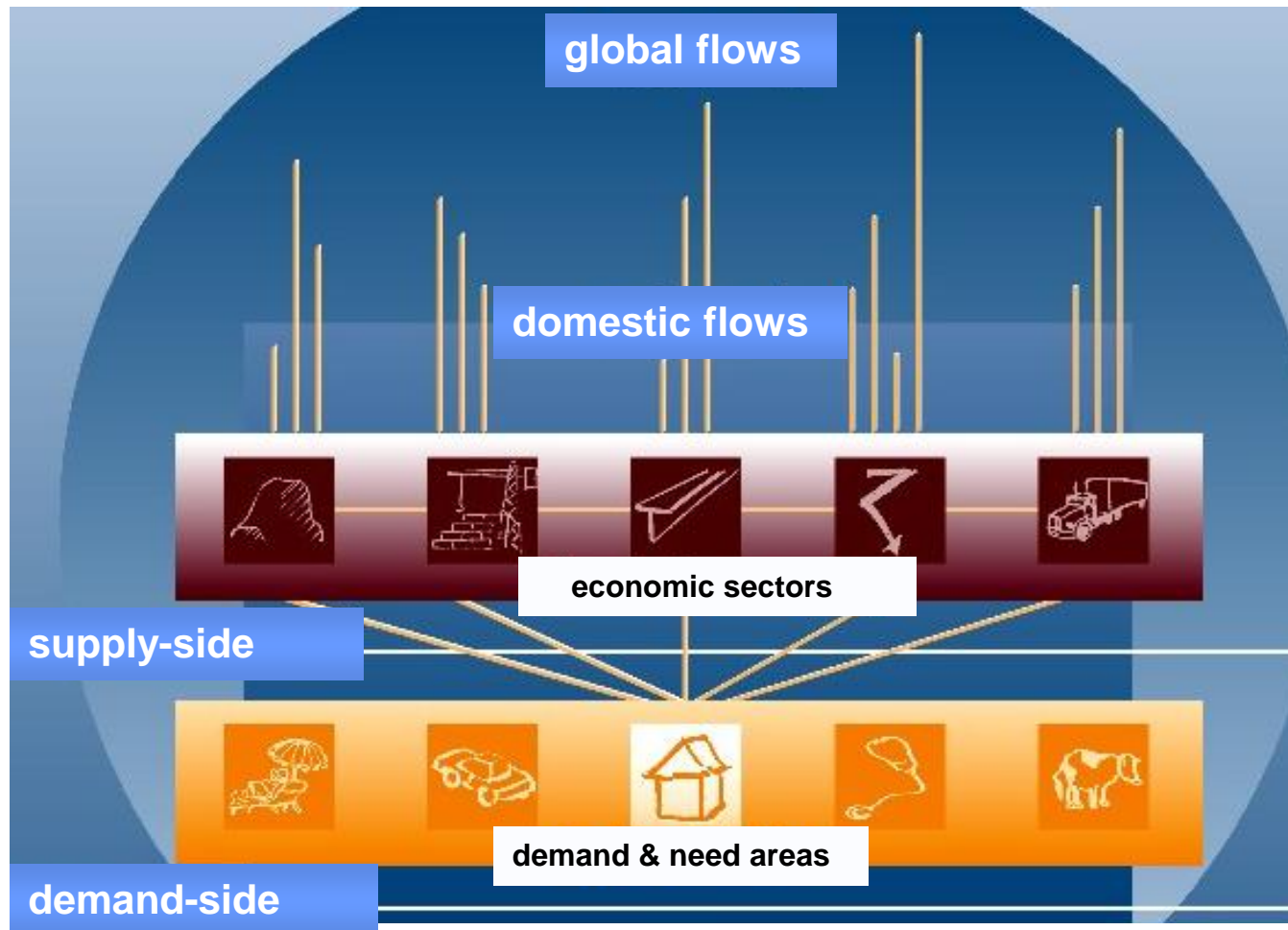
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- Contribute to extend **sustainability** criteria to **all** bioenergy (Joint Workshop series with JRC, EEA etc.), current focus on C balance of forest bioenergy
- Define criteria/indicators for sustainable **bioeconomy** (EU Biomass Policies, S2Biom)
- **International** (transatlantic) discussion through IEA Bioenergy Tasks 40 + 43, UNEP, FAO...
- **GBEP**: testing the sustainability indicators for bioenergy (national level), possible revision

# Material Flow Analysis (MFA)



# Local & Global Flows



**Cross-sectoral** + **cross-boarder** material & energy flows + transports

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# Material & Economic Flows

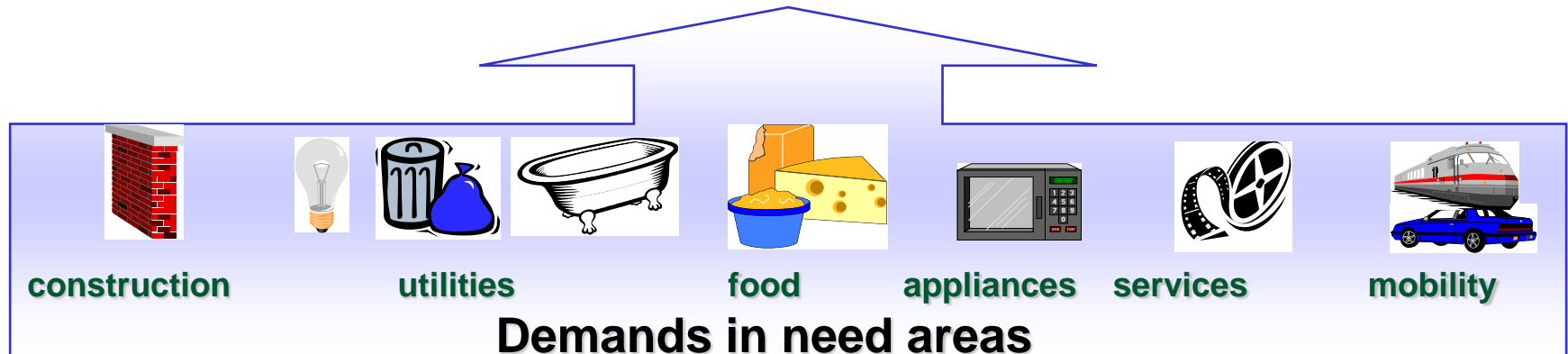
**socio-economic effects:  
life-cycle costs, employment**

**environmental effects**

**economic/material flow analysis**

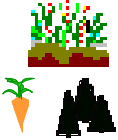







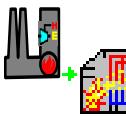

**consumer prices**

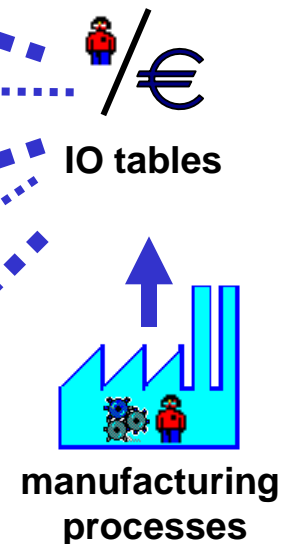
**mass/energy**





# Employment Flows

	process	direct	indirect*
	extraction/ harvesting		€
	transport		€
	processing, manufacturing		€
	transport		€
	use		€



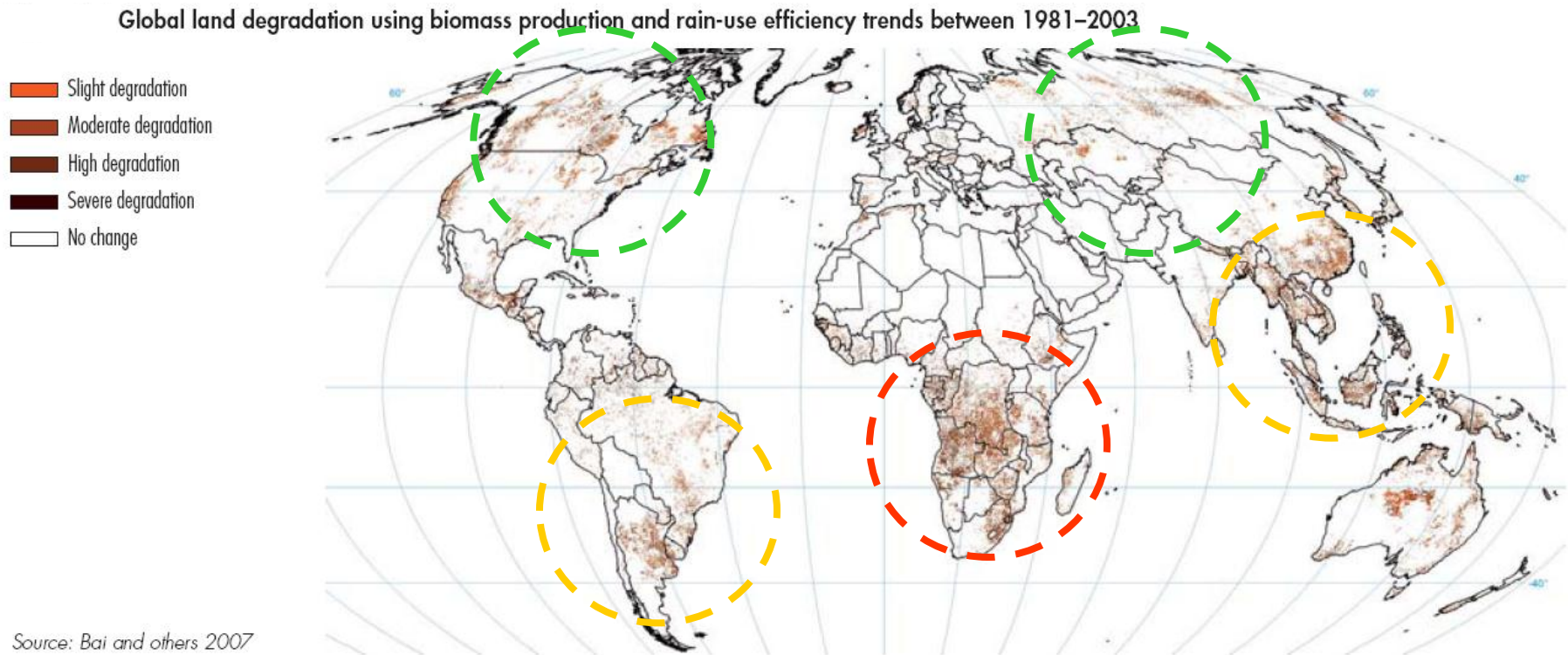
\* = from investment & operating (non-fuel) costs



# Degraded Land Mapping

## FAO's Land Degradation Assessment in Drylands (LADA):

Identification of “black spots” of land degradation by trends analysis



# Degraded Land for Biomass?

## Mapping of degraded land and biodiversity: Country studies in Brazil, China and South Africa



see final report of the German "Bio global" project (FKZ 3707 93 100)

Land type	Area	energy	reference
degraded land	0.4-0.6 billion ha	8 - 110 EJ/a	Hoogwijk et al. (2003)
	2.50 billion ha (19% of land area)	~ 500 EJ/a	Metzger/ Hüttmann (2009)
abandoned land	0.4 billion ha	27 EJ/a	Field et al. (2008)
marginal and degraded land	1.1 – 1.4 billion ha	150-200 EJ/a	Cai, Zhang, Wang (2011)
		90 EJ/a	Wicke (2011)
water-scarce, marginal + degraded		70 EJ/a	ECN et al. (2009)

**Global data without ground truthing,  
but country studies show:**

correction factor needed, approx 20%  
as conservative estimate

**→ up to 5% of global energy demand**

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# Quantitative Analysis: Biodiesel

	CO <sub>2</sub> eq	SO <sub>2</sub> eq	PM <sub>10</sub>	CEU <sub>non-renew</sub>	land use	resource eff.
<b>diesel fuels from</b>	<b>g/MJ<sub>fuel</sub></b>	<b>g/GJ<sub>fuel</sub></b>	<b>g/MWh<sub>el</sub></b>	<b>MJ<sub>prim</sub>/MJ<sub>fuel</sub></b>	<b>m<sup>2</sup>/GJ<sub>fuel</sub></b>	<b>GJ<sub>fuel</sub>/ha</b>
SME in AR, small-scale 2010	42,4	159	16,9	0,2	259	39
SME in AR, large-scale 2010	23,1	113	10,3	0,2	205	49
SME in AR, 2020	29,8	149	13,8	0,3	251	40
PME in ID, small-scale 2010	49,0	93	79,8	0,1	91	110
PME in ID, 2010	53,6	144	82,8	0,2	87	115
PME in ID, 2020	20,4	123	66,5	0,2	70	142
PME in EU 2020	26,5	220	32,6	0,3	72	139
PME in EU 2030	24,3	205	30,2	0,3	65	154
RME in EU 2020	38,8	15	0,8	0,2	96	104
RME in EU 2030	35,6	11	0,6	0,2	128	78
AME in EU 2020	7,1	12	0,5	0,2	0	
BtL-black-liquor EU 2020	0,3	5	0,1	0,0	0	
BtL-forest EU 2020	15,9	35	3,9	0,2	0	
BtL-SRC EU 2020	26,1	100	6,9	0,3	136	73
BtL-switchgrass AR 2030	28,8	379	29	0,3	221	45
BtL-SRC UA marginal 2030	15,5	2243	11	0,1	171	58
BtL-SRC UA hi-prod. 2030	7,8	993	7	0,1	74	136

Source: own computation with GEMIS (IINAS 2014); SME = soybean methylester; PME = palmoil methylester; RME = rapeseedoil methylester; AME = used cooking oil methylester; BtL = biomass-to-liquid (Fischer-Tropsch diesel); SRC = short-rotation coppice; AR = Argentina; EU = European Union; ID = Indonesia; UA = Ukraine